PROGRAM EXECUTIVE OFFICE MISSILES AND SPACE

Counter-Rocket, Artillery, Mortar (C-RAM)

Mike Van Rassen
C-RAM Program Director

Program Overview Briefing

C-RAM Program Directorate Mission

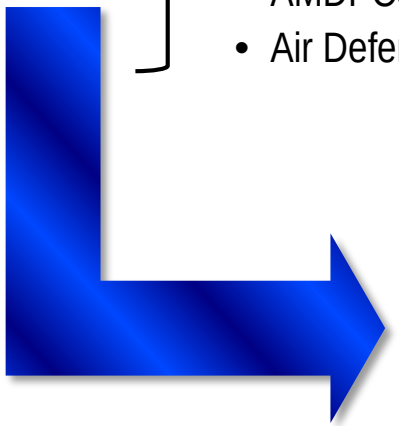
- Responsible for the overall management of activities related to research, development, acquisition, fielding, and sustainment of Rocket, Artillery, Mortar (RAM) Warn to the Brigade Combat Teams (BCT) and for automated Air and Missile Defense command and control (C2) systems, to include Forward Area Air Defense C2 (FAAD C2) and Air and Missile Defense Planning and Control System (AMDPCS).
- Serves as the Lead System Integrator for C-RAM system-of-systems. Responsible for development of C-RAM C2 and the holistic C-RAM capability, and ensuring effective interfaces are developed and maintained between Air Defense C2 and C-RAM systems and the Mission Command Networks and Systems, other services, and allied nations.

C-RAM Portfolio

Emerging C-RAM Systems/Products are Built on the Foundation of Existing Programs of Record

Original Systems and Products

- Forward Area Air Defense Command and Control (FAAD C2) – Acquisition Category (ACAT) II
  - FAAD C2 Software
  - FAAD C2 Sheltered Systems
- Air and Missile Defense Planning and Control System (AMDPCS) – ACAT III
  - Air Defense Airspace Management (ADAM) Cells
  - Air and Missile Defense Workstation (AMDWS)
  - AMDPCS Sheltered Systems at Air Defense Artillery (ADA) Echelons (BN thru AAMDC)
  - Air Defense System Integrator (ADSI) Workstation



Additional Systems and Products

- C-RAM Warfighter Support – Quick Reaction Capability (QRC)
  - Sense, Warn, and Intercept Capability
- Rocket, Artillery, Mortar (RAM) Warn – ACAT III
- C-RAM Intercept to IFPC/Avenger Composite BNs – ACAT III

FAAD/C-RAM C2 Role in Current Programs and Emerging Requirements

- Original PD C-RAM Acquisition Programs
  - FAAD C2 (ORD dated 1995) - fielded force wide as engagement operations (EO) software for SHORAD/Avenger units; links/nets Sentinel Radars until migration to Army Integrated Air and Missile Defense (AIAMD) Integrated Fire Control Network (IFCN)
  - AMDPCS (CPD dated 2008) - component of all ADAM shelter configurations at all echelons for conduct of SHORAD engagement; provides correlated air picture to AMDWS for force operations (FO) and planning and to Mission Command for air situational awareness/understanding
- Homeland Defense of the National Capitol Region
  - Operation Noble Eagle (ONE) - core component of the C2 architecture; USAF leads effort and funds C2 improvements as required
- Theater C-RAM Capabilities (Various JUONs)
  - C-RAM capability is currently deployed at multiple Forward Operating Bases (FOB) in Afghanistan – it is built off FAAD C2 software with changes to integrate other C-RAM component systems, and enhancements as required to overcome shortfalls and keep pace with the evolving threat and changes in enemy tactics
- Transitioning Programs of Record
  - RAM Warn (CPD dated 2010) – horizontal technology insertion of C-RAM warn components and communications into Maneuver Brigade Combat Teams to provide early, localized warning of indirect fire attacks
  - C-RAM Intercept (LPWS) (CPD dated 2013) – CONUS fielding to two Indirect Fire Protection Capability (IFPC)/Avenger Composite Battalions (FY14/15)
- Related Efforts
  - FAAD/C-RAM C2 and AMDWS SW Virtualization in the IBCS server, incorporating new functions to meet Real-Time Safety Critical Embedded (RTSCE) Common Operating Environment (COE) requirements, and modification of ADAM shelter as a core component providing C2 for Avenger, LPWS, RAM Warn, and IFPC-2 Intercept
  - Intercept Enhancements provide C2, Sense, and potential interceptor options for the IFPC Intercept program

FORWARD AREA AIR DEFENSE COMMAND & CONTROL (FAAD C2)

FAAD C2 Program Mission

Mission:

- Rapidly develop, acquire, integrate, test, field, and sustain CONUS or OCONUS FAAD C2 system-of-systems hardware and software to various echelons from ADA Bde to fire unit level, providing them a correlated air picture (Tactical Single Integrated Air Picture) using local and external Army and Joint sensors, linking them to the Mission Command Networks and Systems and the Joint Defense Network (JDN) via various forms of communications to provide timely and accurate correlated operational Air Picture to automate engagement decisions.
- Components include: shelters; communications equipment; and FAAD C2 software, which performs the Engagement Operations, Surveillance, Battle Management, Weapons Coordination & Management functions, as well as interfacing with tactical systems, including Air & Missile Defense Workstation (AMDWS) and Air Defense System Integrator (ADSI).

FAAD C2 gives the Warfighters access to an accurate, correlated, and Real-Time air picture plus weapons control and status facilitating the ADA mission and to *Protect the Force*

FAAD C2 System Description

FAAD C2 is a system-of-systems that integrates software, hardware, and shelter system components

FAAD C2 Software Provides:

- Engagement Operations functions to Maneuver Air and Missile Defense (AMD) and Composite AMD BNs
- Air battle management and situational awareness to the Maneuver Commander via the ADAM Cell
- Low level air picture to DIV/BDEs through the Sensor C2
- Software basis for C-RAM Intercept and Sense/Warn capability
- Automated integration with the Mission Command system

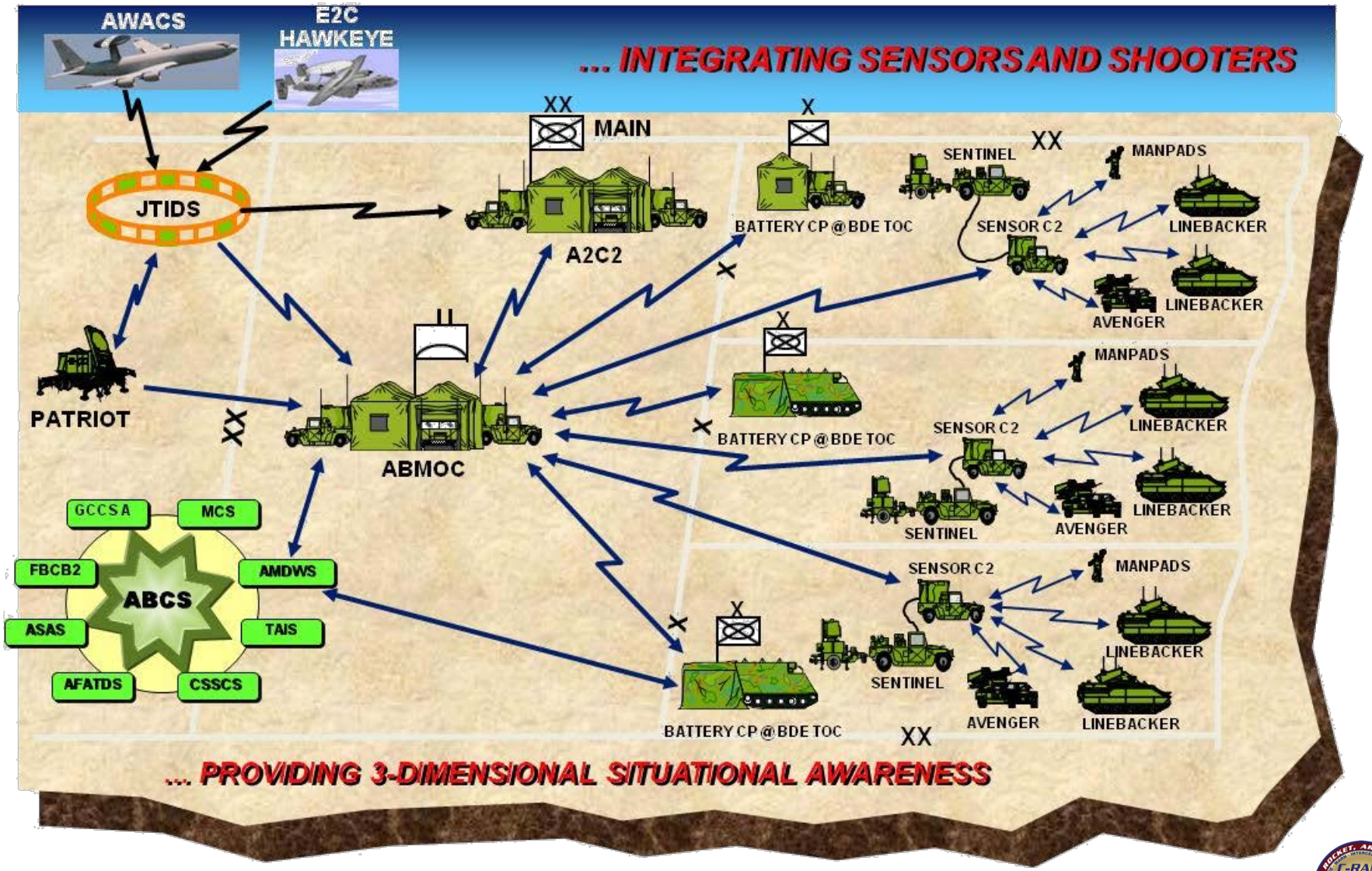
FAAD C2 Shelter Systems:

- Based on an Army standard Rigid Wall Shelter and Command Post Platform shelter
- Are Type Classified-Standard and Materiel Released
- FAAD C2 (and AMDPCS) shelters are mutually supported and can be operationally interchanged

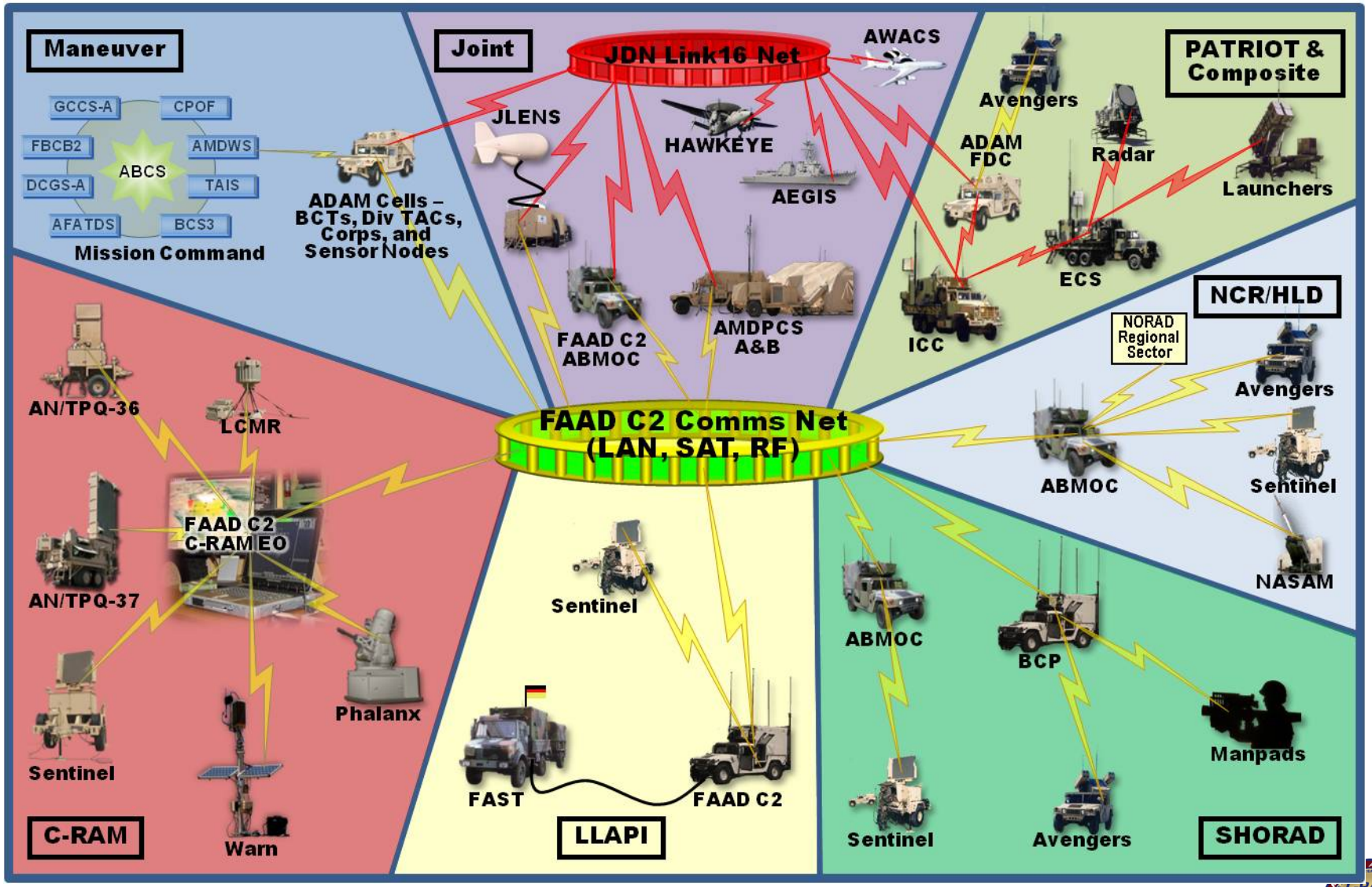
FAAD C2 Fire Unit Hardware Components:

- Forward Area Computer Terminal provides airspace situational data; engagement commands; and weapon coordination, status, and control to Avenger Fire Units
- Critical in preventing fratricide

FAAD C2 SoS Employment (Original OV – Circa 1990)



FAAD C2
Current Capabilities Architecture

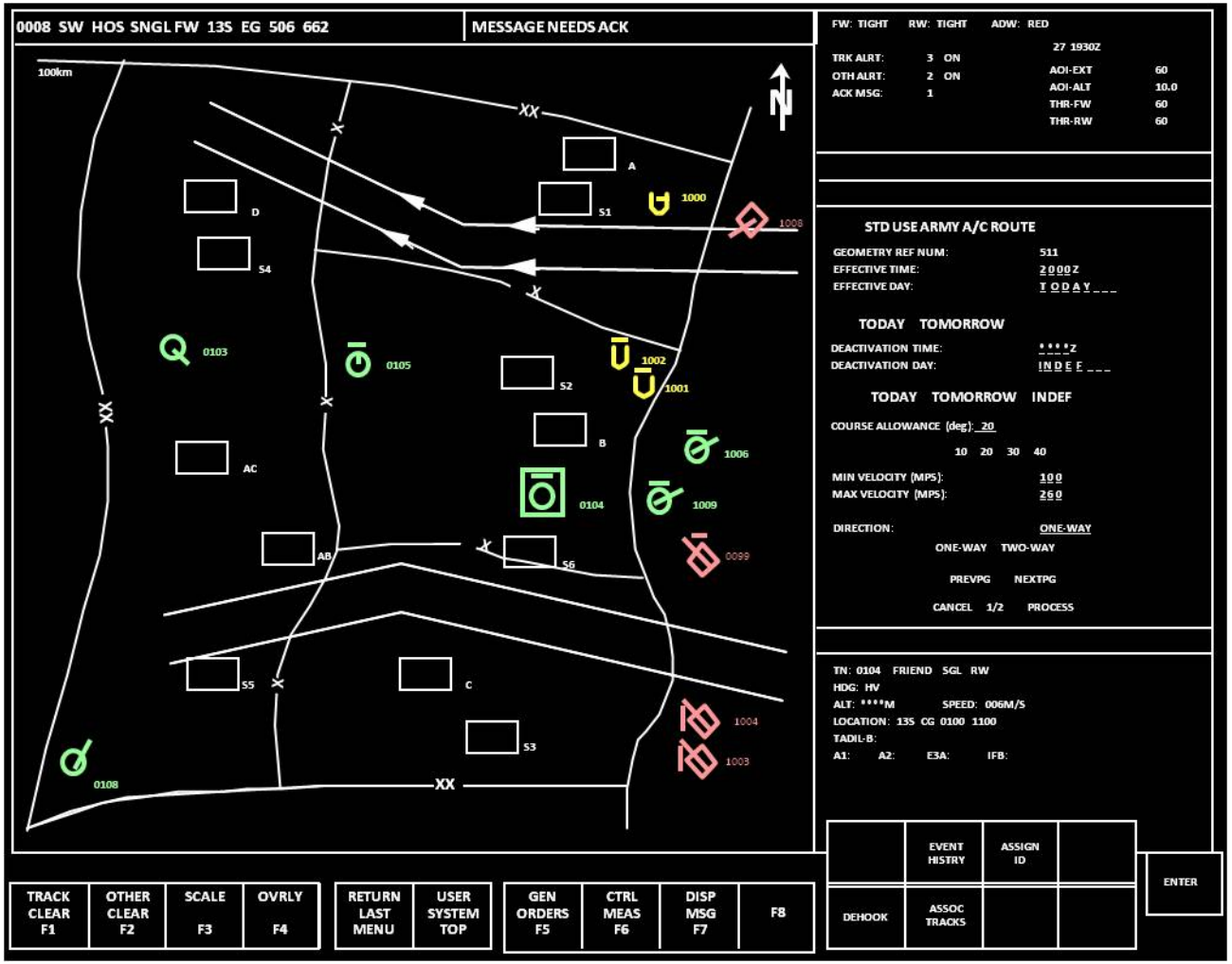


FAAD C2 Engagement Operations

PROVIDES REAL-TIME AIR SURVEILLANCE & BATTLE MANAGEMENT INFORMATION (in 2-D/3-D)

Provides Real-Time Information for:

- Correlated Common Operating Air Picture
- Positive Position Locating Information (PPLI)
- Air Corridors
- Friendly Aircraft
- Enemy Aircraft
- Unknown Aircraft
- Air Defense Unit Locations, including Joint & Coalition Units
- Battlefield Graphics
- Airspace Battle Management
- Weapon Engagement Status
- Weapons System Target Pairing & TCO Functionality Available
- Close Air Support/Point of Origin to Cockpit/Call for Fire



AIR AND MISSILE DEFENSE COMMAND & CONTROL SYSTEM (AMDPCS)

AMDPCS Program Mission

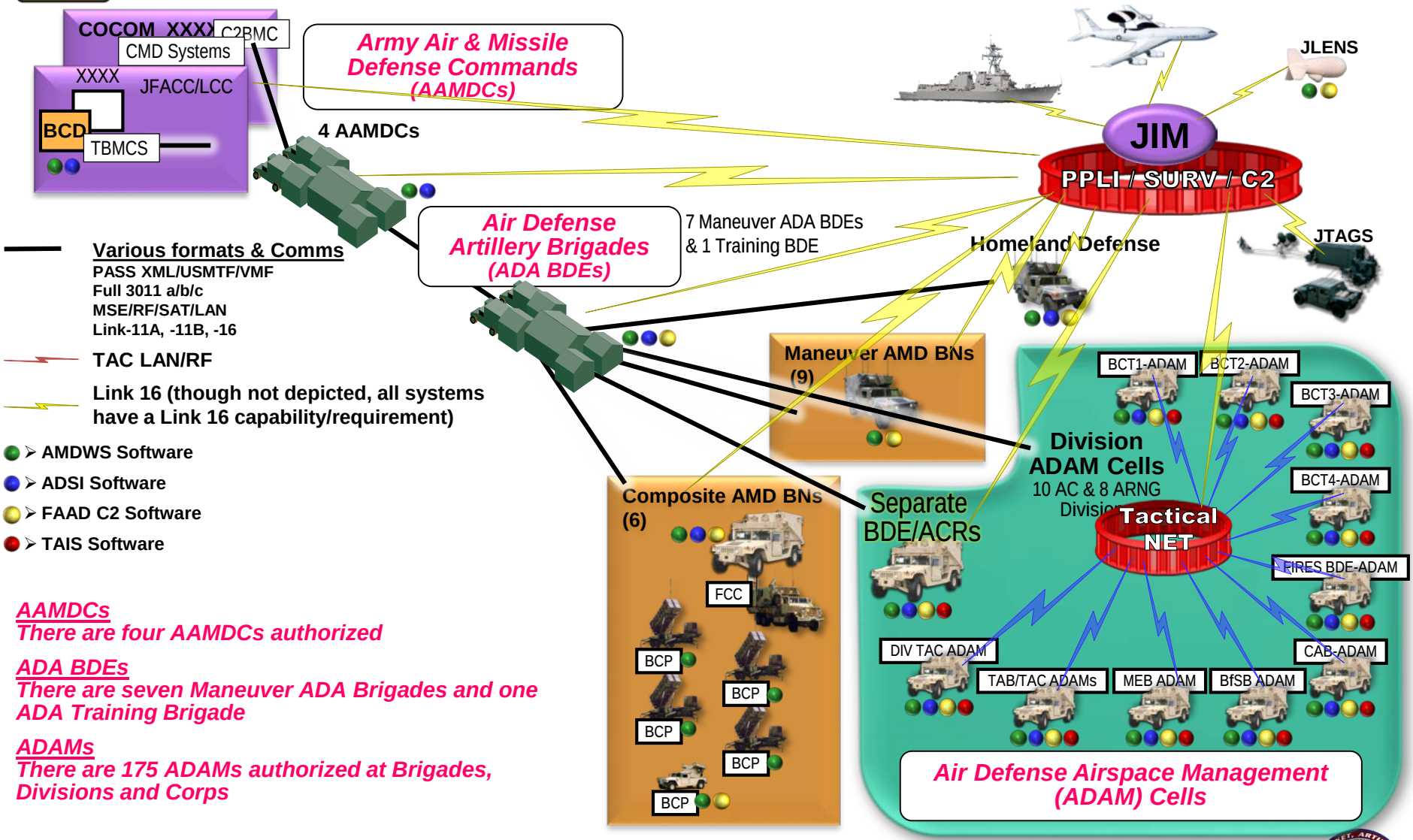
Mission:

- Develop and field operationally effective and supportable, integrated, digitized Air Defense Systems that satisfy the functional information requirements of commanders and staffs at all echelons of command. This is accomplished through the AMDPCS program.
- AMDPCS is the backbone of Army Air Defense through the capability it provides via:
  - Air Defense Airspace Management (ADAM) Cells to the Corps, Divisions, Brigade Combat Teams (BCT), Combat Aviation Bdes, Fires Bdes, Battlefield Surveillance Bdes, and Maneuver Enhanced Bdes
  - Sheltered Tactical Operations Centers (TOC) (ADAM based) to ADA Bdes, Army Air and Missile Defense Commands (AAMDC), Joint C2 elements, Fire Coordination Cells (FCC), and as Battery CPs and Sensor C2 Nodes
  - Components include: Command Post Platform (CPP) shelters, communications equipment, FAAD/C-RAM C2, AMDWS, ADSI, and TAIS (in some applications)

AMDPCS System Description

- Army Objective Force system that provides integration of Air and Missile Defense operations at all echelons
- Shelter systems centered around a single type-classified/materiel-released baseline shelter known as the ADAM Cell
- Depending on echelon, ADAMs are fielded in different quantities at Corps, divisions, BCTs, and Multi-functional Support Brigades (MFSB), and provide Commanders at divisions and BCTs with air defense situation awareness and airspace management capabilities
- AMDPCS configurations are also deployed with Air Defense units including AAMDCs, ADA Bdes, and ADA BNs
- AMDPCS provides two major software systems used in air defense force operations and engagement operations - AMDWS and ADSI
- AMDWS operates on a staff laptop and is a staff planning and battle-space situational awareness tool that provides commanders at all echelons with a common tactical and operational air picture
- ADSI provides a multi-TADL/comms processor capability for external links

AMDPCS Across the Force



AAMDCs
There are four AAMDCs authorized

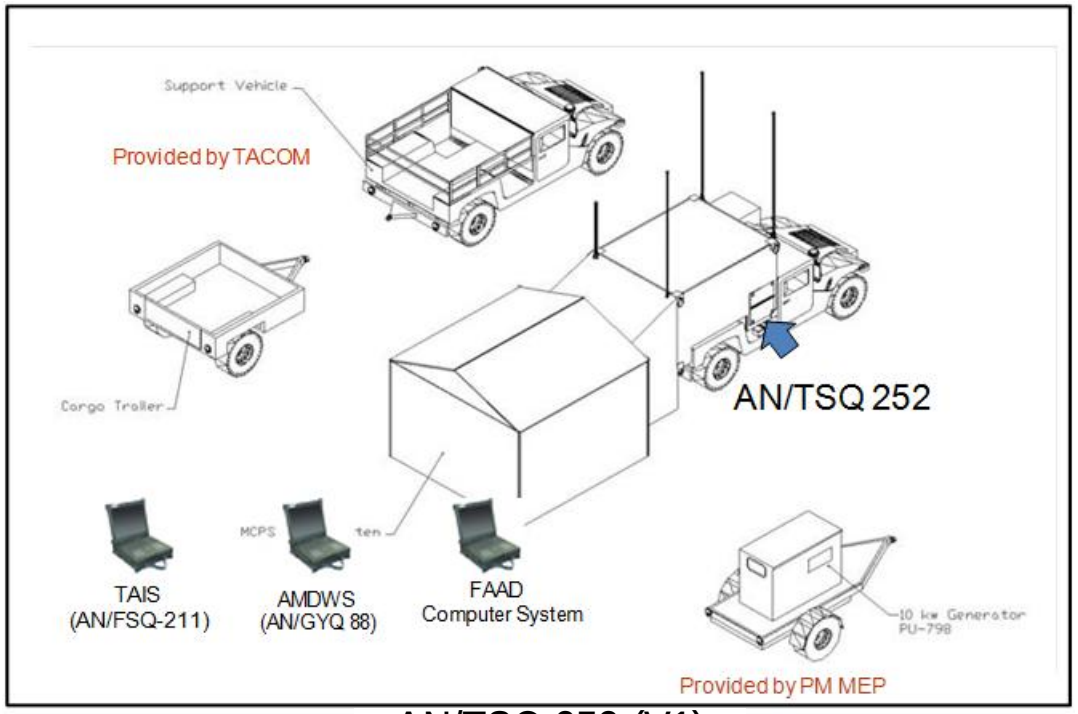
ADA BDEs
There are seven Maneuver ADA Brigades and one ADA Training Brigade

ADAMs
There are 175 ADAMs authorized at Brigades, Divisions and Corps

ADAM System Description

The ADAM, AN/TSQ 253 (V1) Provides:

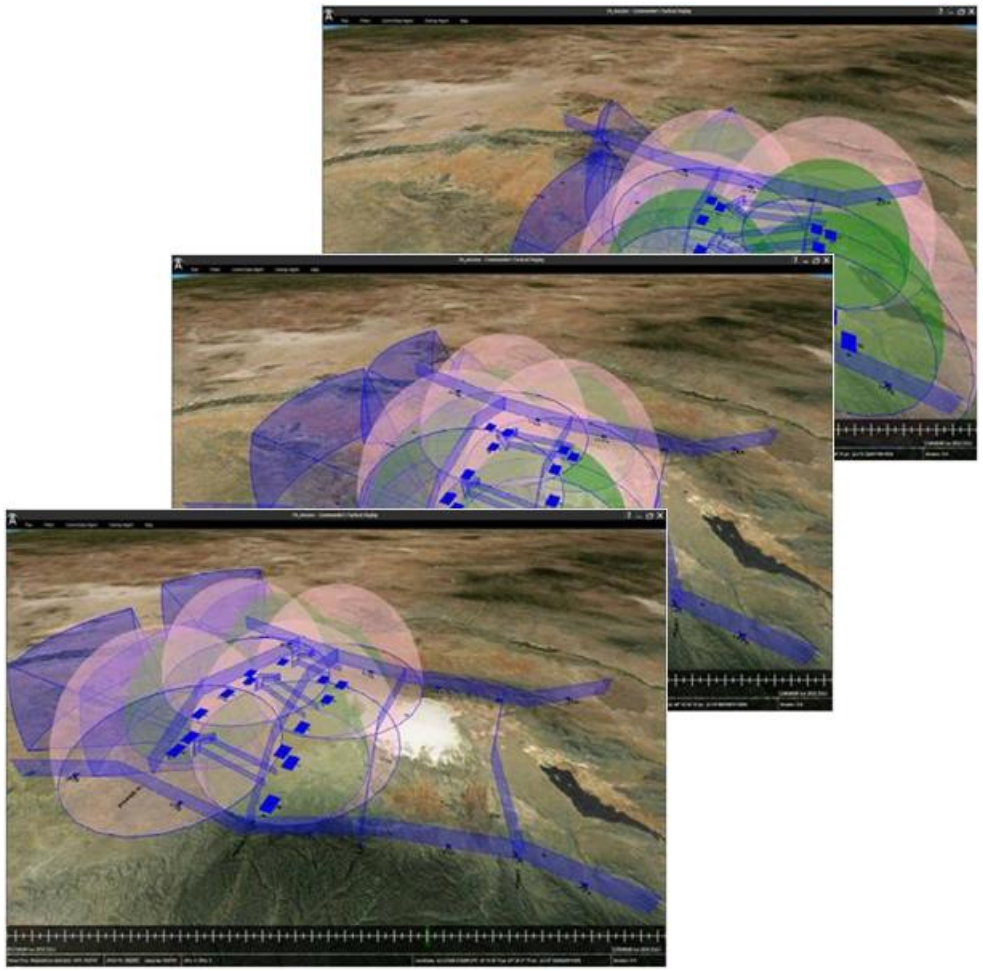
- Three dimensional Air Situational Awareness, early warning, and alerting for Division & BCT CDR (e.g. Air Tracks Visibility & TBMs)
- Radio/chat systems that will allow it to forward TBM launch point, flight of missile, and impact point to subordinate units
- Collaborative Army and Joint AMD Integrated Planning
- Army AMD and AVN Integrated Planning for Current and Future Operations



AN/TSQ 253 (V1)

AMDWS ADA / C-RAM
Force Operations and Planning

- Sensor/Weapon Placement Optimization
- Time Phased Defense Design Planning
- Strategic – Tactical Interoperability
- Joint and Multi-national Interoperability
- Common Operating Picture
  - Combined Regional / Local Air Picture
  - Sensor / Weapon Coverage and Status
  - Air Combat Order (ACO) / Air Tasking Order (ATO) Parsing and Display
- RAM Event Management
  - Fires Coordination (Variable Message Format)
  - Visual Sensor & UAS Tasking
- Defense Design Exerciser
  - Air and Force Protection Analysis
  - Rapid Forensic Analysis



C-RAM WARFIGHTER SUPPORT - SENSE, WARN & INTERCEPT -

C-RAM Requirement/Background

- C-RAM Requirement
  - The Army validated a theater Operational Requirement for a system to destroy rockets and mortar rounds in flight in Sep 04
- C-RAM Capability
  - In Sep 04, the Army directed the Air and Missile Defense Command and Control Systems (AMDCC) Product Office to complete a Proof-of-Principle test of their concept for a C-RAM capability
  - Proof of Principle test was completed in Nov 04 with US Navy Phalanx destroying > 60 % of mortar rounds
    - CG CENTCOM said it met theater requirements and requested immediate fielding
- Results of C-RAM PoP test briefed to Vice Chief of Staff, Army, Secretary of the Navy, and Deputy Secretary of Defense in Dec 04 / Jan 05
  - C-RAM directed to conduct more stressing test – "If successful, Field Immediately"
- First increment of C-RAM test conducted in Feb 05 – validated Sense, Warn
  - ATEC CG said "field immediately" because "it can save lives"
  - C-RAM Sense and Warn capability fielded to first Forward Operating Base (FOB), just 4 months after Proof of Principle test
- Second test increment conducted in Apr 05 – validated Intercept capability
  - Two LPWS systems deployed to Initial FOB in May 05
- Multiple improvements have been incorporated, responding to Lessons Learned by soldiers and to respond to changes in threat tactics

C-RAM Sense, Warn, Respond Capability Currently Deployed at Multiple FOBs in Afghanistan, with Intercept Capability Deployed at Some of These – Mission Continues

C-RAM Functions/Pillars in Countering the IDF Threat

Senses Indirect Fire (IDF) and Air Breathing Targets (ABT)

Warns personnel within hazard area of predicted impact point

Warn 3.0

Intercepts rocket or mortar round in flight, precluding lethal effects on the ground

LPWS

AI3

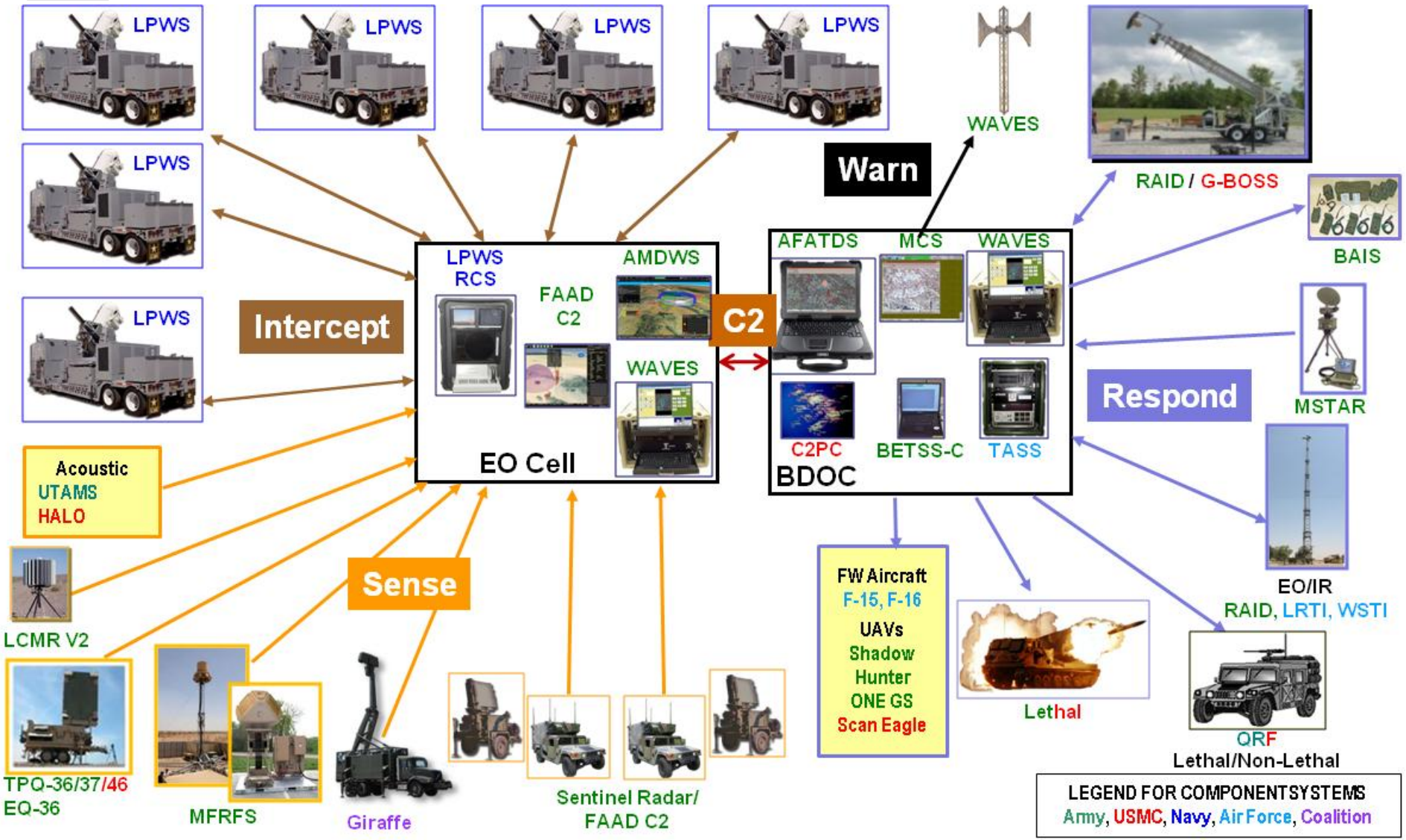
Provides Command and Control by modified versions of standard Army C2 systems

FAAD C2

- Coordinates/enables lethal or non-lethal Response through the Mission Command systems
- Shapes the battlefield by assessment of threat data collected by C-RAM systems
- Protect deals with the consultation and coordination of physical barriers, bunkers, and other measures to provide physical force protection

- Requires a Holistic Approach - No One System/Component can Perform the Mission
- Modular, Scalable, and Tailorable Capability Based on Mission Need and Available Resources

C-RAM Sense, Warn, Intercept & Enhanced Response Validated Architecture



C-RAM Performance in Combat

- LPWS systems have achieved more than 200 successful intercepts of a rocket or mortar round fired at high value assets
- C-RAM Sense, Warn, and Respond performance has also been extremely successful, providing timely Warning for more than 4000 rocket or mortar attacks against C-RAM FOBs, with a minimum of False Warnings
  - This enables troops in the hazard area to lie prone or seek protection prior to impact
  - C-RAM has also supported successful Response resulting in capture/destruction of IDF crews and caches
- C-RAM operational performance exceeds its initial performance in testing at Yuma
- C-RAM Sense, Warn, Intercept, and Respond performance is enhanced by the creation of "Super FOBs"…linking FOBs together

C-RAM Systems Operational Readiness Rate Currently Exceeds 95%, Operating 24/7 in an Extreme Heat and Dust Environment!

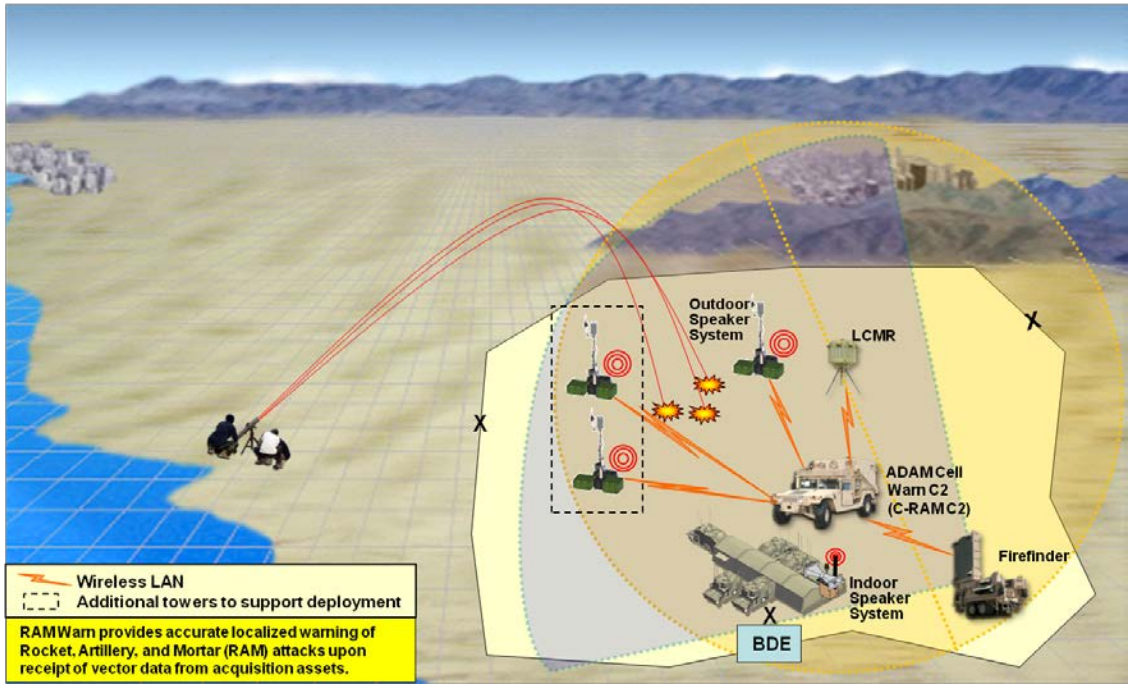
RAM WARN

RAM Warn Requirement

- Why is RAM Warn needed?
  - Due to an increased number of Indirect Fire (IDF) attacks against US forces
- What it provides to the Warfighter?
  - Provides the Soldier early warning of an IDF attack via localized audio/visual warning, thus reducing personnel casualties
- Requirements Document
  - IFPC Increment 1 Capability Production Document (CPD), 6 August 2010, CARD # 0782
  - RAM Warn CPD, 1 May 2012, CARD #0782 retained; update reflects program name change
  - ACAT III, Joint Staffing Designator: Independent (not a joint program)
  - Representative Warn capability at the Maneuver BCTs, with operational expansion via access to Army Prepositioned Stock (APS) as required based on mission needs
    - APS suites consist of two (2) outdoor Warn systems and seven (7) indoor Warn systems

RAM Warn Operational Concept

- RAM Warn primary mission is to warn U.S. forces of incoming Indirect Fire (IDF) attacks
- IDF attacks comprise a significant portion of all Soldier casualties
- Overview of the RAM Warn capability
  - Begins with the acquisition of an IDF launch by two or more independent sensors (radars) acquiring the same event within a given time frame
  - FAAD C2 confirms that detection event is an actual IDF launch, determines Point of Impact (POI) and Time of Impact of IDF rounds
  - Based on the POI, FAAD C2 then determines which warn nodes should send “Incoming” warning alarms and transmits this information to the appropriate warning nodes



RAM Warn System Overview

Target Acquisition Platoon

LCMR MILTOPE

LCMR AN/TPQ-50

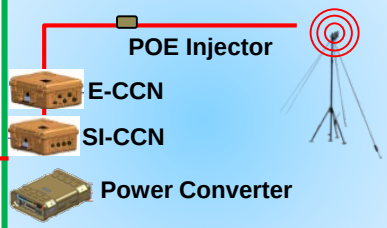
LCMR C2 Link X 4

LIN R05010-Radar Data Transfer System AN/TSC

Firefinder C2 Link X 2

Legacy

AN/TPQ-36 & 37 Firefinder Radar



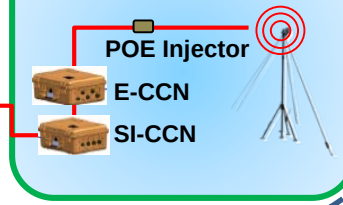
LIN R05011-Radar Data Transfer System AN/GSC

OR

Objective

AN/TPQ-53

X 2



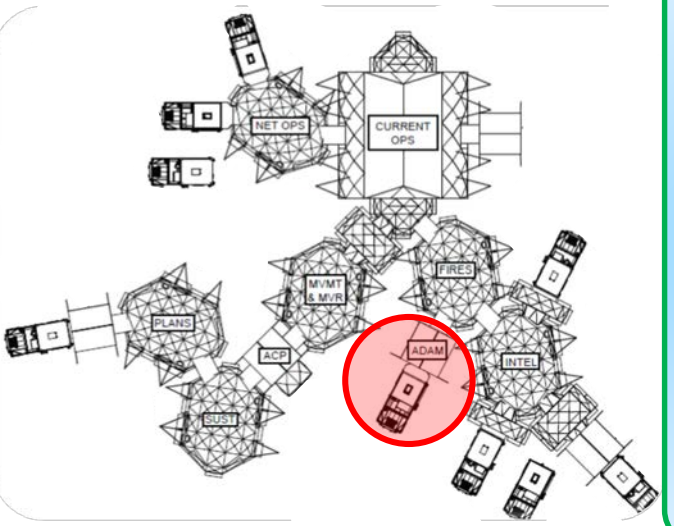
FA BN Retransmission

Rajant Wireless Kit X 2

- 1x Blue Sky Mast
- 1x POE Injector
- 1x Rajant Radio

LIN T05031-Transmitting Set, Countermeasures AN/GLT-4

Brigade TOC



Indoor C2 x 1

BC Cdr X4

Push to Talk

E-CCN

POE Rajant

LIN P05022-Public Address Set AN/TIC-41

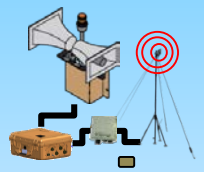
Blue are PM Provided

Red Unit Property – unit provides power

Additional RAM Warn equipment will be made available as Army Prepositioned Stock (APS) for deploying units based on mission needs

BDE Remote

Indoor Warn X 1



1x E-CCN
1x POE Injector
1x Rajant Radio
1x ACC
1x Mast

LIN A05019-Alarm Set, Personnel Hazard AN/GIC-28

Outdoor Warn X 1

1x E-CCN
1x POE Injector
1x Rajant Radio
1x STWE
1x Mast
1x Speaker

LIN E05009-Emergency Communication Relay Group OA-9535/G

What is Required to Field RAM Warn to a BCT?

- Minimal additional equipment / training is required for the current ADAM Cell crew and shelter to operate the RAM Warn capability
  - Training requires only 3 weeks
  - Additional equipment is required to provide the Warning capability
    - Warning devices, both external and internal
    - Communications to link Warning devices to FAAD C2 workstation
- Army fielding concept for RAM Warn
  - Each BCT is provided a "slice" of the equipment required to provide BCT Warning, with the remaining equipment maintained in APS
  - The "slice" of equipment at each BCT is sufficient to conduct training, maintain operator skills, and support exercises
  - In a deployment the required RAM Warn equipment is provided to the BCT via access to APS

C-RAM INTERCEPT TO IFPC/AVENGER COMPOSITE BATTALIONS

C-RAM Intercept Requirement

- In DEC 2011, the G-3/5/7 approved a Directed Requirement, stating:
  - LPWS would be fielded to 2 ADA battalions without modifications, to provide an interim capability until IFPC Increment 2-Intercept is fielded
  - 5-5 ADA Effective Date of 1QFY14 and 2-44 ADA Effective Date of 1QFY15
  - TRADOC tasked to develop the C-RAM Intercept (LPWS) Capability Production Document (CPD)
- Force Design Update (FDU) for IFPC/Avenger composite battalion approved in JAN 12
- 5-5 ADA MTOE approved in DEC 12
- CPD and Acquisition Decision Memorandum (ADM) approved in AUG 13

C-RAM Intercept Concept of Operations

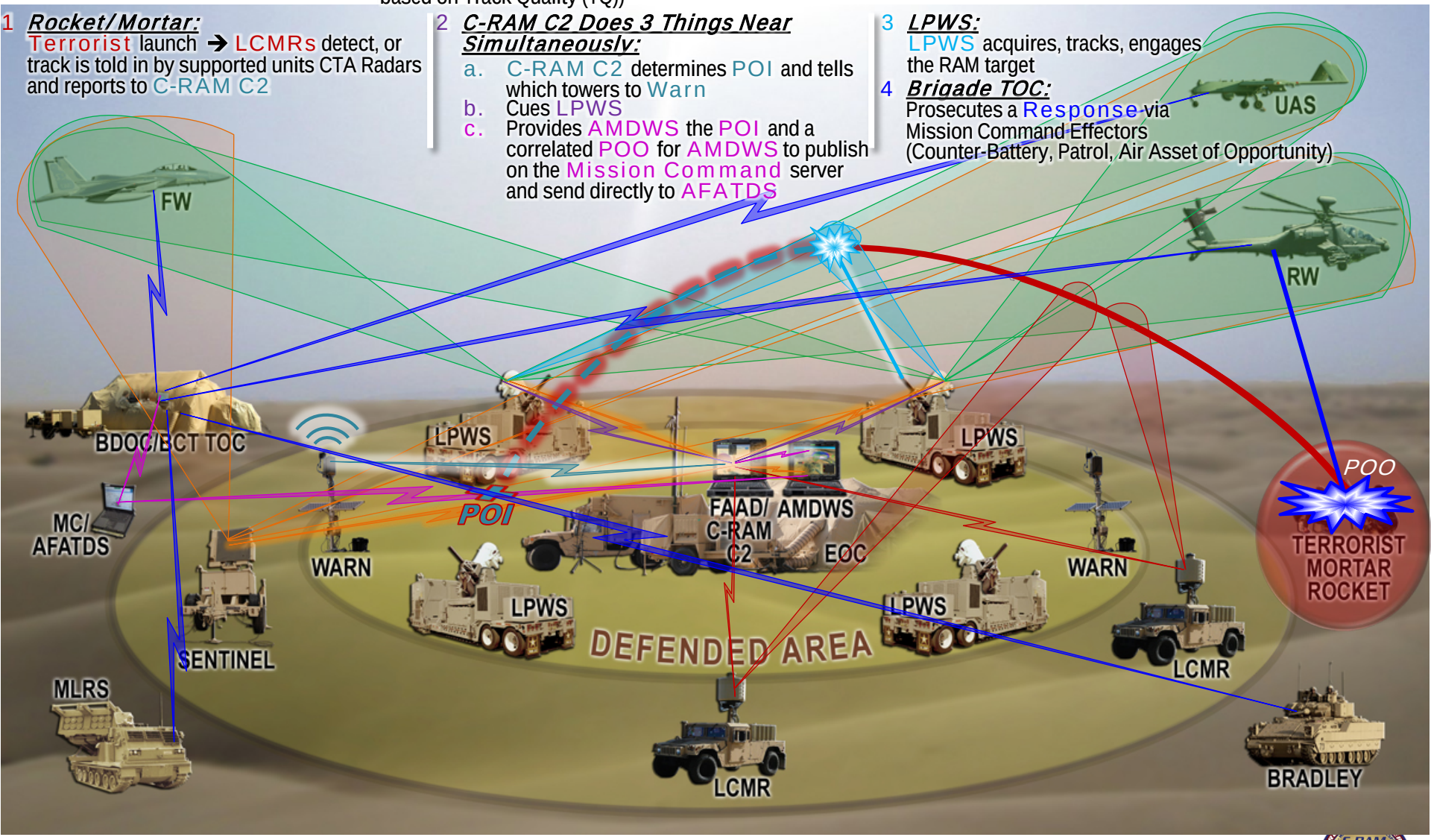
Continuous: Sentinel → C-RAM C2 → AMDWS and LPWS (Do Not Engage Sector (DNES) based on Track Quality (TQ))

1 ***Rocket/Mortar:***
Terrorist launch → LCMRs detect, or track is told in by supported units CTA Radars and reports to C-RAM C2

2 ***C-RAM C2 Does 3 Things Near Simultaneously:***
a. C-RAM C2 determines POI and tells which towers to Warn
b. Cues LPWS
c. Provides AMDWS the POI and a correlated POO for AMDWS to publish on the Mission Command server and send directly to AFATDS

3 ***LPWS:***
LPWS acquires, tracks, engages the RAM target

4 ***Brigade TOC:***
Prosecutes a Response via Mission Command Effectors (Counter-Battery, Patrol, Air Asset of Opportunity)



LPWS Transition

Fielding LPWS to IFPC/Avenger Composite BNs

SHORAD BN → C-RAM LPWS Intercept Composite BN → IFPC Inc 2-I Blk 1 Potential Composite BN (Notional) → IFPC Inc 2-I Blk 2 (Notional)

Current Design

Avenger BN

Avenger BTY

4x3x3=36

x8

Near Term Design

IFPC/ Avenger BN

Avenger BTY

LPWS BTY

4x3x1=12

4x3x2=24

x2

x6

Mid Term Design

IFPC/ MML BN

MML BTY

LPWS BTY

4x3x1=12

4x3x2=24

x2

x6

Long Term Design

MML BN

MML BTY

4x3x3=36

x6

Summary

- Transition of deployed C-RAM SoS capability to the Institutional Army as an Enduring Capability is underway (e.g., RAM Warn, C-RAM Intercept)
  - C-RAM functions/pillars (C2, Sense, Warn, Intercept, etc) are agile, evolutionary, block vs. incremental efforts
  - Each function/pillar is or can be independent of the others with the exception of C2, which is common to all
- C-RAM C2 software plays a vital role in FAAD C2, AMDPCS, and all C-RAM efforts, as well as other emerging efforts including Integrated Air and Missile Defense (IAMD)
- PD C-RAM is working with ASA(ALT) and HQDA Staff to establish appropriate Programs of Record and funding lines